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EDITORIALS

Body mass index and mortality: understanding the patterns and paradoxes

People who are lean for life have the lowest mortality

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The optimal body mass index (BMI) associated with lowest risk of all cause mortality is not known. As excess adiposity increases risk of conditions such as diabetes that reduce life expectancy, one might expect increasing BMI to be associated with increasing mortality. However, compared with normal weight, underweight is associated with increased mortality and modestly elevated BMI is associated with lower mortality. The former pattern is only partly explained by confounding by smoking or comorbidity, and the second observation has been called the obesity paradox.[1] In addition, the influence on mortality of different patterns of weight change throughout the life course is poorly understood. Two linked papers attempt to shed light on these important subjects.[2 3]

Aune and colleagues (doi:10.1136/bmj.i1256) report a meta-analysis of 230 prospective studies with more than 3.74 million deaths among more than 30.3 million participants, providing further evidence that adiposity (measured by BMI) increases the risk of premature death.[2] Some increase in risk was observed in lower weight participants, and in the analysis of all participants the lowest mortality was observed with a BMI of around 25. However, the lowest mortality was observed in the BMI range 23-24 among never smokers, in the BMI range 22-23 among healthy never smokers, and in the BMI range 20-22 among studies of never smokers with longer durations of follow-up (≥20 and ≥25 years). The findings show the importance of smoking and comorbidity in confounding the association between BMI and mortality and contributing to the apparent paradox of a U shaped association.

The attenuation of the observed J shaped relation in analyses confined to never smokers with longer follow-up and the finding of the lowest mortality in the BMI range 20-22 in this group suggest that any increased mortality among never smokers with low BMI is probably a result of residual confounding from unidentified comorbidity. However, the authors were unable to investigate how changes in weight over time might influence their findings.

In a second paper (doi:10.1136/bmj.i2195), Song and colleagues used an interesting strategy to try to find out how weight trajectories from age 5 to 50 years influence all cause and cause specific mortality among adults over 60 years of age.[3] Having validated an approach in an earlier study in which people were asked to identify their body shape from outline drawings of different body shapes (somatotypes),[4] the investigators studied associations between changes in somatotypes over time and mortality outcomes, using data from two large US prospective cohort studies.

They identified five common patterns or weight trajectories: lean-stable, lean-moderate increase, lean-marked increase, medium-stable/increase, and heavy stable/increase. Unsurprisingly, the authors found that people who reported remaining lean throughout life had the lowest mortality and that those who reported being heavy as children and who remained heavy or gained further weight had the highest mortality. Gaining weight from childhood to age 50 was associated with increased mortality compared with people who reported remaining lean. Weight gain was more strongly associated with cardiovascular than all cause mortality, and the effect was more pronounced among never smokers than ever smokers.

The association between weight gain and cancer mortality was also stronger among never smokers than ever smokers, presumably owing to the higher proportion of obesity related cancers among non-smokers. The stronger association between weight gain and mortality among people with diabetes suggests that diabetes may act as marker of metabolically unhealthy obesity within strata of BMI with the adverse effects of hypertension, dyslipidaemia, and insulin resistance added to the adverse effects of hyperglycaemia. Such findings are a reminder that BMI by itself is an imperfect measure of adiposity.

Recall of body shape is also an imperfect measure. Correlation coefficients between objective and subjective levels of adiposity varied between r=0.36 and r=0.66 in different age groups of

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men and women. Misclassification bias seems likely, although what effect this might have on the study's findings is unclear. Interestingly, the authors did not identify repeated loss and regain of weight (weight cycling) as a separate trajectory. This pattern of weight change is thought to increase risk of diabetes, but limited evidence exists to support an effect on mortality.[5 6]

In conclusion, the study by Aune and colleagues suggests an optimal BMI for lowest mortality likely to apply to European and North American populations. Optimal BMI can be expected to vary by age, ethnicity, and the proportion of people with comorbidity in different populations, and secular declines in mortality may have been even more marked if the prevalence of obesity had not increased. The study by Song and colleagues is an important step forward in furthering our understanding of how weight gain over the life course, particularly in mid-life, is likely to influence health and mortality. Major challenges remain in finding effective ways to prevent weight gain, support weight loss, and prevent weight re-gain, in both individuals and populations.

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